CLAIMS

What is claimed is:

1. A method for generating a basis material decomposition conversion table or function, comprising:

characterizing one or more component characteristics of an X-ray imaging system;

selecting a pair of basis materials with respective attenuation coefficients;

generating a set of projection values for each of two or more energy spectra using the one or more component characteristics and the attenuation coefficients to simulate the responses of the X-ray imaging system to a plurality of lengths of the basis materials; and

generating at least one of a table and a function from the sets of projection values and the one or more component characteristics.

2. The method as recited in claim 1, wherein the one or more components comprise at least one of a detector array, an X-ray source, and an X-ray filter.

3. The method as recited in claim 2, wherein characterizing at least one of the X-ray source and the X-ray filter comprises characterizing at least one of a peak kilovoltage, an X-ray energy level, and an X-ray spectrum.

4. The method as recited in claim 2, wherein characterizing the detector array comprises characterizing a detector response.

5. The method as recited in claim 1, wherein the X-ray imaging system comprises a dual-energy CT imaging system.

6. The method as recited in claim 1, wherein the X-ray imaging system comprises a dual-energy projection X-ray imaging system or a dual-energy X-ray tomosynthesis imaging system.

7. The method as recited in claim 1, wherein the basis materials comprise at least one of bone, soft tissue, and contrast agent.

8. The method as recited in claim 1, wherein the plurality of lengths of the basis materials represent the dynamic range of the X-ray imaging system.

9. The method as recited in claim 1, wherein the sets of projection values comprise one or more interpolated projection values.

10. The method as recited in claim 1, further comprising determining a density line integral set for one of the basis materials using a measured projection set and at least one of the table and the function.

11. The method as recited in claim 1, further comprising determining a line integral set representative of a photoelectric effect or a Compton effect for one of the basis materials using a measured projection set and at least one of the table and the function.

12. A method for generating a map of a basis material, comprising:

generating a first projection set of an object at a first X-ray energy level and a second projection set of an object at a second X-ray energy level;

generating a line-integral projection set using the first projection set, the second projection set, and at least one basis material decomposition table or function; and

reconstructing the line-integral projection set to form a map.

13. The method as recited in claim 12, wherein the line-integral projection set comprises one of a density line-integral projection set, a photoelectric line integral projection set, and a Compton line integral projection set.

14. The method as recited in claim 12, wherein the line-integral projection set comprises a density line integral projection set and the map comprises a density map.

15. The method as recited in claim 12, wherein the at least one basis material decomposition table or function is a basis material decomposition table or function associated with a basis material and the density map comprises a map of the basis material.

16. The method as recited in claim 15, wherein the basis material comprises one of bone, soft tissue, and contrast agent.

17. The method as recited in claim 12, wherein the at least one basis material decomposition table or function comprises at least one of a bone decomposition table or function, a soft tissue decomposition table or function, and a contrast agent decomposition table or function.

18. The method as recited in claim 12, wherein the at least one basis material decomposition table or function comprises a bone decomposition table or function and the density map comprises a bone map.

19. The method as recited in claim 12, wherein the at least one basis material decomposition table or function comprises a soft tissue decomposition table or function and the density map comprises a soft tissue map.

20. The method as recited in claim 12, wherein the at least one basis material decomposition table or function comprises a contrast agent decomposition table or function and the density map comprises a contrast agent map.

21. The method as recited in claim 12, further comprising associating the density map with one or more adjacent density maps to form a volume rendering.

22. A computer program, provided on one or more computer readable media, for generating a basis material decomposition conversion table or function, comprising:

a routine for generating a set of projection values for each of two or more energy spectra using one or more component characteristics of an X-ray imaging system and attenuation coefficients for a pair of basis materials to simulate the responses of the X-ray imaging system to a plurality of lengths of the basis materials; and

a routine for generating at least one of a table and a function from the sets of projection values and the one or more component characteristics.

23. The computer program as recited in claim 22, wherein the one or more component characteristics comprise a peak kilovoltage, an X-ray energy level, an X-ray spectrum, a detector response.

24. The computer program as recited in claim 22, wherein the X-ray imaging system comprises one of a dual-energy CT imaging system, a dual-energy projection X-ray imaging system, and a dual-energy X-ray tomosynthesis imaging system.

25. The computer program as recited in claim 22, wherein the basis materials comprise at least one of bone, soft tissue, and contrast agent.

26. The computer program as recited in claim 22, further comprising a routine for calculating one or more interpolated projection values for inclusion in one or the sets of projection values.

27. The computer program as recited in claim 22, further comprising a routine for determining a density line integral set for one of the basis materials using a measured projection set and at least one of the table and the function.

28. The computer program as recited in claim 22, further comprising a routine for determining a line integral set representative of a photoelectric effect or a Compton effect for one of the basis materials using a measured projection set and at least one of the table and the function.

29. A computer program, provided on one or more computer readable media, for generating a map of a basis material, comprising:

a routine for generating a first projection set of an object at a first X-ray energy level and a second projection set of an object at a second X-ray energy level;

a routine for generating a line-integral projection set using the first projection set, the second projection set, and at least one basis material decomposition table or function; and

a routine for reconstructing the line-integral projection set to form a map.

30. The computer program as recited in claim 29, wherein the line-integral projection set comprises one of a density line-integral projection set, a photoelectric line integral projection set, and a Compton line integral projection set.

31. The computer program as recited in claim 29, wherein the line-integral projection set comprises a density line integral projection set and the map comprises a density map.

32. The computer programs as recited in claim 29, wherein the at least one basis material decomposition table or function is a basis material decomposition table or function associated with a basis material and the density map comprises a map of the basis material.

33. The computer program as recited in claim 32, wherein the basis material comprises one of bone, soft tissue, and contrast agent.

34. The computer program as recited in claim 29, wherein the at least one basis material decomposition table or function comprises at least one of a bone decomposition table or function, a soft tissue decomposition table or function, and a contrast agent decomposition table or function.

35. The computer program as recited in claim 29, wherein the at least one basis material decomposition table or function comprises a bone decomposition table or function and the density map comprises a bone map.

36. The computer program as recited in claim 29, wherein the at least one basis material decomposition table or function comprises a soft tissue decomposition table or function and the density map comprises a soft tissue map.

37. The computer program as recited in claim 29, wherein the at least one basis material decomposition table or function comprises a contrast agent decomposition table or function and the density map comprises a contrast agent map.

38. The computer program as recited in claim 29, further comprising a routine for associating the density map with one or more adjacent density maps to form a volume rendering.

39. A X-ray image analysis system comprising:

an X-ray source configured to emit a stream of radiation;

an X-ray filter configured to filter the stream of radiation;

a detector configured to detect the stream of radiation and to generate one or more signals responsive to the stream of radiation, wherein the detector comprises a plurality of detector elements;

a system controller configured to control the X-ray source and to acquire a set of projection data from one or more of the detector elements via a data acquisition system; and

a computer system configured to generate a set of projection values for each of two or more energy spectra using attenuation coefficients for a pair of basis materials and one or more component characteristics of at least one of the X-ray source, the X-ray filter and the detector to simulate the responses of the detector to a plurality of lengths of the basis materials, and to generate at least one of a table and a function from the sets of projection values and the one or more component characteristics.

40. The X-ray image analysis system as recited in claim 39, wherein the one or more component characteristics comprise at least one of a peak kilovoltage, an X-ray energy level, an X-ray spectrum, and a detector response.

41. The X-ray image analysis system as recited in claim 39, wherein the basis materials comprise at least one of bone, soft tissue, and contrast agent.

42. The X-ray image analysis system as recited in claim 39, wherein the computer is further configured to determine a density line integral set for one of the basis materials using the set of projection data and at least one of the table and the function.

43. The X-ray image analysis system as recited in claim 39, wherein the computer is further configured to determine a line integral set representative of a photoelectric effect or a Compton effect for one of the basis materials using the set of projection data and at least one of the table and the function.

44. An X-ray image analysis system, comprising:

an X-ray source configured to emit a stream of radiation;

a detector configured to detect the stream of radiation and to generate one or more signals responsive to the stream of radiation, wherein the detector comprises a plurality of detector elements;

a system controller configured to control the X-ray source and to acquire a first projection set of an object at a first X-ray energy level and a second projection set of an

object at a second X-ray energy level from one or more of the detector elements via a data acquisition system; and

a computer system configured to generate a line-integral projection set using the first projection set, the second projection set, and at least one basis material decomposition table or function and to reconstruct the line-integral projection set to form a map.

45. The X-ray image analysis system as recited in claim 44, wherein the line-integral projection set comprises one of a density line-integral projection set, a photoelectric line integral projection set, and a Compton line integral projection set.

46. The X-ray image analysis system as recited in claim 44, wherein the line-integral projection set comprises a density line integral projection set and the map comprises a density map.

47. The X-ray image analysis system as recited in claim 44, wherein the at least one basis material decomposition table or function is a basis material decomposition table or function associated with a basis material and the density map comprises a map of the basis material.

48. The X-ray image analysis system as recited in claim 47, wherein the basis material comprises one of bone, soft tissue, and contrast agent.

49. The X-ray image analysis system as recited in claim 44, wherein the computer is further configured to associate the density map with one or more adjacent density maps to form a volume rendering.

50. A X-ray image analysis system, comprising:

an X-ray source configured to emit a stream of radiation;

an X-ray filter configured to filter the stream of radiation;

a detector configured to detect the stream of radiation and to generate one or more signals responsive to the stream of radiation, wherein the detector comprises a plurality of detector elements;

a system controller configured to control the X-ray source and to acquire a set of projection data from one or more of the detector elements via a data acquisition system;

a computer system configured to receive the set of projection data;

means for simulating the responses of the detector to a plurality of lengths of a pair of basis materials at two or more energy spectra to generate a set of projection values for each of two or more energy spectra; and

means for generating a basis material decomposition table or function from the sets of projection values.

51. The X-ray image analysis system as recited in claim 50, wherein the means for simulating utilizes at least one of peak kilovoltage, an X-ray energy level, an X-ray spectrum, and a detector response.

52. The X-ray image analysis system as recited in claim 50, wherein the basis materials comprise at least one of bone, soft tissue, and contrast agent.

53. The X-ray image analysis system as recited in claim 50, further comprising means for determining a density line integral set for one of the basis materials using the set of projection data and at least one of the table and the function.

54. The X-ray image analysis system as recited in claim 50, further comprising means for determining a line integral set representative of a photoelectric effect or a Compton effect for one of the basis materials using the set of projection data and at least one of the table and the function.